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The American Association for the Advancement of Science:
Pandemic Botany: DR. C. STUART GAGER 285
Obituary:
Andrei Vassilievitch Martynov: PROFESSOR T. D. A. COCKERELL. *Recent Deaths and Memorials* 292
Scientific Events:
Presentation of the Philadelphia Award to Professor Richards; Symposium at the University of Notre Dame; Award of the Laetare Medal; Election of Fellows of the Royal Society, London; The Federation of American Societies for Experimental Biology 293
Scientific Notes and News 295
Discussion:
Shock Disease and the Snowshoe Hare Cycle: DR. ROBERT G. GREEN and CARL L. LARSON. *Production of Wheals in the Human Skin:* PROFESSOR HAROLD A. ABRAMSON. *Sauropod Dinosaur Remains in the Upper Cretaceous:* C. W. GILMORE. *A New Record for Fresh-water Medusae in Pennsylvania:* DR. KIMBER C. KUSTER. *New Exposures of Ordovician Bentonite in Southwestern Virginia:* ROBERT L. BATES 298
Scientific Books:
General Catalogue of Stars: DR. H. R. MORGAN. *Quantum Mechanics:* DR. KARL LARK-HOROVITZ 300
Special Articles:
Inhibition of Parturition in the Rabbit by the Injection of Estrogenic Hormone: DR. GEORGE P. HECKEL and DR. WILLARD M. ALLEN. *Localization of Calcium in Paramecium caudatum:* ALBERT I. LANSING. *The Presence of a Type- and Species-Specific Conjugated Polysaccharide in Type I Pneumococcus:* DR. M. G. SEVAG. *The Bitterling Ovipositor Reaction to Corticosterone:* W. FLEISCHMANN and S. KANN 302
Scientific Apparatus and Laboratory Methods:
Micro-Scissors: DR. MARSHALL HERTIG. *The Preparation of Dopa-Melanin:* DR. L. EARLE ARNOW 306
Science News 10

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PANDEMIC BOTANY[1]

By Dr. C. STUART GAGER

DIRECTOR, BROOKLYN BOTANIC GARDEN

IN his "Life and Letters of Sir Joseph Dalton Hooker," Leonard Huxley tells us that early in 1867 Sir Joseph "was urged" to accept nomination at the next meeting of the British Association for the presidency for 1868. Whether any American botanist ever had to be "urged" to accept the presidency of the Botanical Society of America "deponent sayeth not." In fact, there is no historical record that any such method of securing a president for this society was ever tried. The method is that of the botanist in search of material for study. He goes out into a field of unsuspecting plants, seizes the one he wishes, puts it into his vasculum and closes the lid. Later, in the laboratory, he brings out the plant, makes longitudinal and cross sections, peels off the epidermis, soaks some of it in chloral hydrate to make it transparent and by various other ruthless details of technique compels the plant to disclose its most intimate and personal characteristics. Everything so disclosed is embodied in a "contribution to knowledge" and published where all the world may read.

So the committee on nominations of this society meets in secret conclave and decides on a few names, as soldiers are drafted for war. To safeguard the principle of democracy (still dear to science), the entire membership is urged to do likewise. From the preliminary list of victims so chosen the plebiscite of the society makes the final choice of one. He is not "urged" nor even invited; he is notified. A careful search of the literature of this subject has failed to disclose a single instance of a botanist so lacking in unselfish patriotism as to refuse to serve his botanical country in her time of presidential need.

And then comes the laboratory treatment, in all the brilliant setting of an annual dinner, when the *retiring* president is compelled to advance and, like the

[1] Address of the retiring president of the Botanical Society of America, given at the "Dinner for all Botanists" at Indianapolis, on December 29, 1937.

plant (sectioned and made transparent), he is forced to disclose to the botanical world, in a presidential swan song, his weak as well as his strong points as a man, a botanist and, alas, as an orator.

But to return to Sir Joseph Hooker. He wrote to Darwin as follows:

> The fact is that I have an insuperable aversion to high places; the acceptance would have been bad dreams in anticipation for 18 months, and a downright surgical operation at the end of it! I believe I inherit this from my father who would never put himself forward, or be put forward, and I am sure it paid in the end.

But there was a more urgent reason why Hooker shrank from a presidency. "I was also actuated," he says, "by the fact that I can see no way to a good Address"! But, says Huxley, "he had to yield to the insistence of all the botanists he respected, and . . . 'in a state of deep dejection,' bids Darwin pity him."

In May he wrote to Darwin:

> Perhaps when this Norwich meeting is over I shall feel more at ease. I would give 100 guineas that it were over, even with a failure, a fiasco, or worse. The address is *nowhere* yet, and I look on its prospects with a loathing that cannot be uttered.

In another letter to Darwin he wrote:

> I get more and more unhappy about the Address as the time draws on. Nothing on earth would induce me to do a thing so *damned indelicate* as to force such a position on an unwilling soul. Science might go to the Devil before I would do so by an enemy even. You see I am working myself up to the starting point. . . . And after all, should a President's Address be a 'scientific thesis'? I think not.

Three months later (in July), after having begun to work on his "Address," he wrote again to Darwin:

> I do not intend to show any part of the address to my wife, from the conviction that she would burn it all. . . . I have concluded the rough sketch of what I shall say (if not hissed down), for by George I would hiss anybody who would eruct such stuff as I have written under any other circumstances than a Presidential martyrdom.

This, then, is what we are this moment in the midst of—a "presidential martyrdom."

At the service in the Norwich Cathedral, on the Sunday following Hooker's address, the anthem, we are told, was specially chosen for him:

> What though I trace each herb and flower,
> That drinks the morning dew,
> Did I not own Jehovah's power,
> How vain were all I knew.

"This," wrote Sir Joseph, "brought tears to my eyes!"

The addresses of the retiring presidents of this society have dealt with an interesting and commendable variety of topics. I do not recall one that has dealt definitely and directly with the problem of botany serving the public or with botanical institutions. Coming down to the present moment, should a president's address be a "scientific thesis?" "I think not," said Hooker—three honeyed words to a retiring president consigned by fate to spend the larger part of his professional career in administration instead of investigation! I have heard the contrary opinion expressed with emphasis by members of this society.

These addresses are among the best opportunities that science has of interpreting itself to the world at large—of helping the lay public to appreciate its larger grasp, its major problems, its significant results, its social values and, above all, its method of thought and work; and botanical science—that is, "pure science," has still not completed its task of interpreting and "selling" itself to the general public, from whom in last analysis, must come both its moral and financial support. If any one should question this statement let him ask himself how many botanical foundations there are comparable in the initial expenditure and the amount of the permanent funds, with what has been done during the past forty years for geology, or for astronomy in the construction and endowment of planetariums for instruction and observatories for research.

By this time it must be evident to all that this address is not to be devoted to presenting the scientific results of research. But research has other than scientific results and applied results. I refer to the impression made by scientific research and researchers on intelligent laymen. What impression is it making on the world outside of its own circle?

So far as concerns inventions—telephone, radio, x-ray therapeutics and a myriad others resulting from the application of research—there can be no question. The impression is profound and profoundly favorable. But what impression are research *per se* and researchers (as distinguished from invention and inventors) making on such groups as writers, editors, educators, educational administrators and those of other professions?

I happened to be present at the meeting of the British Association, in 1927, when the Bishop of Ripon, in the Parish Church of Leeds, made the startling suggestion for a moratorium on all research in science for a term of years, until the scientific and educational world had an opportunity to digest and assimilate what had been accomplished to date. I quote from the newspaper report of the bishop's sermon:

> Dare I even suggest, at the risk of being lynched by some of my hearers, that the sum of human happiness, outside of scientific circles, would not necessarily be re-

duced if for, say ten years, every physical and chemical laboratory were closed and the patient and resourceful energy displayed in them transferred to recovering the lost art of getting together and finding a formula for making the ends meet in the scale of human life?

It would give 99 per cent of us who are non-scientific some chance of assimilating the revolutionary knowledge which in the first quarter of this century one per cent of the explorers have acquired. The one per cent would have leisure to read up on one another's work; and all of us might go meanwhile in tardy quest of that wisdom which is other than and greater than knowledge and without which knowledge may be a curse.

As things stand today, we could get on without further additions for the present to our knowledge of nature. We cannot get on without a change of mind in man.

We could hardly believe the headlines in the morning paper featuring the bishop's radical proposal. One might as well suggest "New Deal" legislation by Congress providing that water should no longer run down hill. For researchers engage in research (that is, those worth considering in such a discussion as this do) for the same reason that streams flow; for the same reason that lawyers become lawyers and not doctors, or that physicians become physicians and not bankers—because it is their nature to do it. It might be rational to propose that Congress pass no more laws for a decade, but not to propose that Congressmen cease to be politicians.

I have just implied that there are researchers not worth considering in such a discussion as this. We are all familiar with them—scientific hewers of wood and drawers of water, who would make excellent teachers if they could feel secure in devoting the best of their energies and talents to teaching, but whose chief inspiration to research is the knowledge that, as a rule, advancement in our higher educational institutions comes not, strange as it may seem, by engaging in formal education, but by the augmentation of knowledge.

If circumstances had compelled Isaac Newton or Charles Darwin or Louis Pasteur or the great Linnaeus to spend most of their time and energy with large classes in introductory courses, the loss to science would have been greater than the gain to education. On the other hand, if our universities would encourage and reward many on their scientific faculties to do just that, the loss to science would be negligible and the gain to education incalculable.

There are a few cases, such as Louis Agassiz and Sir J. J. Thomson, where outstanding ability in both research and classroom teaching are combined in one individual. But are not such cases as Agassiz and Thomson the exception rather than the rule? On the other side of the picture is Professor Mason B. Thomas, professor of botany in Wabash College from 1891 to 1912, and known to all the older botanists as one of the greatest teachers of botany America has produced. What a pity it would have been for Thomas, with his pedagogical gifts, to have made his classroom work secondary to such research as he probably would have done, with his heart and soul in teaching. By giving the best of himself to his classes he became the inspirer of investigators as well as of other teachers; he inspired many to become botanists, and rendered a major service to the science.

I can never forget how my own initial enthusiasm in a certain branch of botany was almost completely and permanently killed by a college professor who was more interested in his own research than in the class of which I was a member. Of course, in the process of advancing science, wood has to be hewn and water has to be drawn, but what a pity to have it done by young men and women who might be so much more valuable to their university, and so much happier, by deliberately subordinating research, for which they have only mediocre ability, to teaching for which they have a natural aptitude and enthusiasm.

We have all had graduate students who have mastered the current technique of research, but have never shown the slightest originality in the formulation of problems or the improvement of procedure. It is a disservice to encourage them in research, or to lead them to feel that teaching is secondary to investigation, in importance or satisfactions, if only their inclination and their gifts are in that direction. It was Sir J. J. Thomson, whose success as a teacher has already been noted, who once said, "No one but a blockhead ever researched except for fun."

But my intention is not primarily to advance my own ideas. As Diogenes went about with his lamp to seek an honest man, so I have been going about with a mirror to catch reflections of what honest critics are thinking and saying about us as investigators and teachers of science.

An editorial in *Nature* ten years ago (August 13, 1927, p. 215), but valid to-day, pointed out that the tendency to emphasize the value of applied science is closely related to the tendency to confuse instruction in science with technical training. It is the former which has value in preparing young people to take their place effectively in meeting the broad problems which confront society. It is essential, says the writer, that students

> should have a general knowledge of the scope and aims of science, as well as of scientific method, and *the mode in which science envisages and attacks its problems.* It is, however, beyond all question that it should be a general knowledge on broad lines; a specialized training in some highly technical branch of science is neither needed, nor indeed is it desirable. . . . We doubt, however, whether

much of the science teaching in schools, either primary or secondary, could be regarded as science for citizenship instead of science for specialists, and we would welcome a movement which would broaden its scope and change its character.

Last February President Keppel, of the Carnegie Corporation, called attention to the general ignorance of science—of the problems, interests, aims and methods of the investigators in so-called "pure" science and the resulting need of a new type of education, especially in the realm of adult education. Commenting on this, an editorial in the *New York Times* of February 22, 1937, continues as follows:

> No professor of English cherishes the illusion that he is training future poets or essayists. To inculcate a love of good books, to broaden the cultural horizon—that is his aim. But the physicists and chemists and other professors of science teach as if they were bent on graduating professional jugglers of atoms and genes. Conceding that there must be some laboratory work, some instruction in the scientific method, it is, after all, the cultural aspect of science that Dr. Keppel has in mind.
>
> There should be a correlation of the sciences, a systematic revelation of the manner in which the human mind has progressed in its thinking about matter, trees, animals, stars, the universe of life. . . . If college graduates had this broader cultural outlook, we would have more science in the newspapers and even better presentations. . . . If educators would forget that science was not made for scientists alone, Dr. Keppel's dream of generally inculcating the spirit and idealism of science would become a reality soon enough, with the press the most potent of educational allies.

If the editorial writer, just quoted, had been more closely in touch with the progress of science-teaching in our universities he would not, perhaps, have referred to Dr. Keppel's comment as a "dream," for progress toward the ideal he urges has, during the past twenty-five years, at least in botanical teaching, been very much of a reality. The introduction of "orientation courses" in the various sciences is a long stride in that direction. But we have still a long way to go.

For example: When I speak of teaching science I have in mind something much more fundamental than passing on to younger learners the facts about the world of matter and energy and life, important as that is; something which is a much more urgent social need. Briefly stated, it is not merely teaching science, but education through science. The two are not necessarily synonymous.

But current progress in this matter has overtaken the preparation of this address. On December 2, after the above paragraphs were written, Dr. S. Ralph Powers, director of the Bureau of Educational Research of Teachers College, Columbia University, presented to a group of students and faculty members a plan for revising the program of high-school education with science as the central motive. Dr. Sears, professor of botany at the University of Oklahoma, is one of the members of the bureau. The plan involves teaching students "to understand the social responsibilities entailed by scientific advance," so that they may "be able to deal more intelligently with their duties in a modern democracy."

Possibly educators are more alive to the failures of science as a means of education and to its possibilities in that line than are scientists themselves. Again may I hold the mirror up to reflect what those outside the ranks of science are feeling and thinking? In his address at the seventy-third annual convocation of the University of the State of New York, at Albany last October, Mr. Lewis Mumford, author, noted that, among the serious conditions that society faces to-day, "one of the worst is the fact that the increase of scientific knowledge and rational insight [that is, among scientists] has not in itself created a more rationally ordered world. . . . Just the opposite of this has happened. The ordinary man is less capable of understanding and directing in accordance with rational calculations and human judgments the world in which he lives."

To what extent is this "serious condition that society faces to-day" attributable to faulty scientific teaching? Perhaps not at all; perhaps only in part. But at least here is a challenge which should have the serious consideration of every teacher of science. A retiring college president, when asked to state the most important lesson he had learned in his long life as an educator, is reported to have said: "That the human mind has infinite capacities for resisting the introduction of wisdom." Perhaps the teachers of science are confronted with an almost insuperable obstacle to conferring on society what it most needs. This appears all the more likely when we realize that the compulsory education laws of most of our states have filled our high schools and colleges with thousands of young people who have the ability to memorize, but little if any ability to think. The percentage is large; a recent writer has placed it at more than 50 per cent.

The principal of one of the large high schools in New York City recently told me that there are numerous pupils in all the New York high schools who can not read well enough to read the assigned lessons in their text-books. This results because the school law requires all of high-school age to attend school, and promotions to successively higher grades must inexorably go on, without regard to scholastic accomplishment, in order to make room for those promoted from the grades below. The most skilled teacher that ever lived could hardly teach pupils how to think who are catapulted into high school on such a basis and often

against their wishes. Many of them pass on to clutter up the classrooms of the freshman year in college.

But let us again hold up the mirror and see what the non-scientific world is saying about science. In his Elihu Root lecture, at the Carnegie Institution of Washington, on "The Influence of Science and Research on Current Thought," in December, 1934, President Angell, of Yale, referred to the general ignorance of our contemporaries concerning the scientific principles underlying the myriad inventions in use in daily life—the telephone, phonograph, gasoline motor, electric light, radio. The principles which these devices embody, he notes, are not only utterly unknown but unintelligible to the great mass of their beneficiaries.

Adding to the illustrations of President Angell, chosen from physical science, we may cite the enjoyment by the masses of the horticultural varieties of flowers and fruits, major agricultural crops such as cotton, corn and wheat, improved both for quality and yield per acre by applying the principles of botanical science. Yet the vast majority of the masses has little, if any, conception of the scientific method of thought and work by which, and only by which, those principles were established.

The serious proportions in which this ignorance of what science has to teach may manifest itself in the practical affairs of daily life is illustrated by the attempts of governmental officials to determine a year in advance, by legislative enactment, the size of our major agricultural crops, apparently wholly ignoring the uncertain but inevitable factors of plant diseases, insect pests, drought and other vicissitudes of nature.

But when we reply to the indictments of science-teaching we must, of course, remember that not every one studies science in college nor is interested in it; and the results of trying to teach people what they are not interested in can hardly be expected to be very substantial, nor to carry over to life after graduation. And I suspect that the failure of science, since it was accepted into the college curriculum, to reform this world is no greater than the failure of mathematics or logic or philosophy or political economy or any other subject.

However, all this does not release us from the responsibility of clearly formulating and facing the problem of our social responsibility in science-teaching and of continuing to attempt the solution so long as the problem exists.

But the responsibilities of scientists are three-fold—to extend knowledge by investigation, to give formal instruction in schools and to enlighten the general public by popularizing. What do our laymen critics say about popularizing?

A professor of philosophy in Princeton University, Dr. Stace, had an article in the *Atlantic Monthly* for December, 1936, entitled, "The Snobbishness of the Learned." He begins with the story of "a very well-known living writer," who submitted the manuscript of a popular book on a branch of modern science to a fellow expert, who commended it, and then said, "But why do you waste your time writing stuff of this sort?" Dr. Stace then expresses his own thought as follows:

> The impression that philosophical and scientific ideas can not be expressed in plain language to plain people is . . . in large measure due to the fact that philosophers and men of science have not, as a rule, the wit to do it. It is due in plain terms to the stupidity of learned men. . . . They lack, too, that human sympathy with simple people which is also essential if the teachings of science and philosophy are to be made available to the many. . . . The real ground for the disfavor in which popular writing is held among experts is to be found elsewhere. It is rooted in class prejudices. The learned think themselves superior to the common herd. They are a priestly caste imbued with the snobbishness that is characteristic of caste systems.

Toward the end of his article Dr. Stace refers to "the pure popularizer" as "performing an absolutely vital function in the intellectual progress of mankind." Furthermore, he urges that *all* scientific writing, "even of the most original, learned, and abstruse kinds, should aim at being popular *as far as possible.*" This aim is to be sought by avoiding unnecessary scientific jargon.

But let us get a glimpse of what the outside world thinks of research in science. The English magazine, *Nineteenth Century,* for July, 1936, has an article entitled, "A Modern Idea of a University," by Rushton Coulborn, Ph.D. From this I quote as follows:

> To-day teaching in our universities has become definitely subsidiary to research and it is the purpose of this article to show that the dominion of research over teaching is the chief cause of the intellectual anaemia of the universities.
>
> The research tide began to flow in the later seventeenth century, when it was first recognized in England and France that the collection of information about natural phenomena was of national importance. . . . The first influence of this process upon the ancient universities was paralytic. They entered upon a decline from which they scarcely showed signs of emergence until the nineteenth century. As they emerged their reviving energies were directed progressively more and more toward the development of the sciences, with their characteristic method of quantitative research. This not to the exclusions of the humanities, but ultimately toward a great advancement of the place of the sciences in learning.
>
> Creative thought is difficult, and, to the great majority of humanity, impossible. Research, however, in a very real sense, is easy. The choice of direction for research *can* be an act of genius if it consists in the creation of an imaginative hypothesis, to be tested thereafter by the

research itself. But the actual research, in whatsoever field, requires only patience, dexterity and exactness. And it is lamentably true that research *may* be undertaken without any preceding act of creation. No genius is required to perceive merely where there lies something unknown. In an age when the frontiers of knowledge are being advanced in all directions, every student, by placing himself for a moment upon the frontier, can look out into an uncharted area. But it remains true that only an able man can divine, from his frontier station, whether he is gazing into a land of promise or merely into the back of beyond. . . . The ordinary, undistinguished individual can, on the other hand, usually be trained to patience, dexterity and exactness in early education. . . . Hence a very large number of ordinary people are available to do research. In this sense research is easy.

It almost appears that research has made the academic world safe for democracy. An army of excellent but very ordinary persons is carrying research further and further into the pettyfogging and unimportant.

The vast majority of university teachers are to-day primarily researchers, and the havoc they have wrought in undergraduate studies is wide-spread. . . . It is the function of the teacher to interest and to inspire, but the numbing influence of research upon character is the very thing to destroy the teacher's ability to discharge this function. . . .

These are the men who have turned lectures into an annual repetition of deceased ideas, or into a cold compound of trivialities drawn from their own and their colleagues' research. As a result much disgraceful cant is talked nowadays in depreciation of lectures as a medium of instruction. The fact remains that Nature designed the lecture to be the most direct stimulus to thought since it is eminently the *milieu* in which emotion enters into and illuminates understanding. Much of the hollowness of the "clash of minds" to-day is attributable to the drying up of the rhetorical, inspirational side of academic education.

The danger is that research should be considered to be the business of the leaders of thought. For the second-class scientist, economist, or historian research offers a living. There should be properly equipped laboratories for research both in the humanities and in the sciences. They should be equipped with permanent full-time staffs, conducting themselves entirely as clerks—since the work is essentially clerical—and not partly as teachers. . . . University teachers themselves should be asked to make recommendations to the research directors, indicating the subjects upon which they desire information. The researchers, in turn, should make reports to the teachers of the material they think to be available, but here the connection should cease.[2]

To give such a long quotation is justified by its amazing character, and its evidence of what the intellectual world outside of science is thinking of *us*. I am not presenting it as embodying my own ideas; far from it. But for how large a group Dr. Coulborn is spokesman we can not be sure, and such comment as I have quoted, in a magazine of contemporary thought of such standing as the *Nineteenth Century*, can hardly be passed over with merely a smile, for what the outside world is thinking and saying of science-teaching and research must always be a matter of serious concern to scientists.

But Dr. Coulborn is not the only contemporary writer who is saying things like this. Let us turn the mirror on a critic in our own ranks. At the opening of the school of medicine of Columbia University, last September, Dr. Nolan D. C. Lewis, director of the New York Psychiatric Institute, addressed the 200 incoming students as follows: "Sometimes I think men are needed who can arrange in synthesis the facts already discovered more than we need new facts."

I next hold the mirror up to the world of college presidents and deans, and catch the following reflection of a recent address by Dr. Glenn Frank, formerly president of the University of Wisconsin:

> The future of America is in the hands of two men—the investigator and the interpreter. . . . And we have an ample supply of investigators, but there is a shortage of readable and responsible interpreters, men who can effectively play mediator between specialist and layman. . . . Science owes its effective ministry as much to the interpretative mind as to the creative mind. . . . Rarely do the genius for exploration and the genius for exposition meet in the same mind. . . . The investigator advances knowledge. The interpreter advances progress. . . . A dozen fields of thought are to-day congested with knowledge that the physical and social sciences have unearthed, and the whole tone and temper of American life can be lifted by putting this knowledge into general circulation. But where are the interpreters with the training and the willingness to think their way through this knowledge and translate it into the language of the street? I raise the recruiting trumpet for the interpreters.

Said Dean Lyon, of the University of Minnesota Medical School, discussing "Teaching and Research" in a recent number of the Sigma Xi *Quarterly* (December, 1936): "What the world needs is not less science, but more knowledge of what science is and what it can and can not do. What the world needs is more and better teaching."

The quotations in this address seem important enough, or at least interesting enough, to bring to the attention of this audience, because they are not isolated utterances, but fair random samples of current opinion.

We have been holding the mirror up to contemporary thought to see what the critics are thinking and saying of us as scientific investigators and teachers. Mirrors reflect everything in front of them, and we should be unfair to ourselves if we did not regard the adverse criticisms in the light of certain other

[2] This, of course, is a fairly correct picture of the organization of research in the laboratories of some of our great industries.

reflected facts. I refer, for example, to the indispensible services rendered to government and to humanity by such institutions as the Greenwich Observatory and Kew Gardens in England, and the Bureau of Standards, the Department of Agriculture, the Agricultural Experiment Stations in the United States—services which depend upon a continuing program of scientific research.

The Union of Soviet Socialist Republics began by overthrowing much that was considered fundamental in the old régime, but it did not overthrow science. Lenin, Stalin and other leaders saw in the beginning that no substantial progress could be made except with science, organized primarily, not for the sake of science, it is true, but for the service of government. An editorial on this in the *New York Times* for November 21, 1937, stated that "the successive Five Year Plans could not be carried out without the aid of physicists, chemists, biologists, and engineers. Hence the 40,000 scientists employed in the various research institutes—2,179 in the 51 laboratories under the direction of the Academy of Sciences alone. . . ." As the editorial states, the Academy of Sciences is as much a part of the government as our Department of Agriculture.

Such considerations as these reveal the sheer nonsense of the proposal for a ten-year moratorium on scientific research, but they also support the prevailing but erroneous impression that it is only applied science, rather than science in education, that has social value.

But we should also realize the danger of science being dominated by the state, which, as in Russia and also in Germany (if we may rely on Associated Press dispatches), is liable to approve freedom of inquiry only when its results are in harmony with current political doctrine. Witness, for example, the denunciation of genetics by Lyssenko because the political philosophy of Karl Marx teaches that all members of the proletariat are equal. Science for politics is quite as futile as science for science's sake.

I have entitled this address "Pandemic Botany"—that is, botany for all the people whose interest in plant life may be encouraged or initially aroused. And, as most presidential addresses before the Botanical Society have dealt with the major enthusiasms of the speakers, I have thought it might not be out of place, at this time, to present, in broad outline, certain aspects of my own major enthusiasm, namely, the work of the Brooklyn Botanic Garden, as a concrete illustration of the organization of a program of botanical research and education for "Everyman."

In developing this institution the underlying thought has been, "Anything scientific or educational based upon plant life," beginning with children's gardens and studies in preparation for them, and culminating in a program of botanical research. There is one intentional gap in the plan, for advanced courses of university type are not included, since the Botanic Garden grants no degrees, and there is little or no demand for such courses except from candidates for a degree.

Aside from labeled objects placed on public exhibit, the most common educational device of museums and botanic gardens is the public lecture, usually illustrated and usually offered free. For reasons too numerous to be stated here, free public lectures, each, according to the practice, dealing with a topic largely unrelated to the others, have been almost entirely eliminated at the Brooklyn Botanic Garden, especially with children. Experience has shown that lecturing to a large audience of from 500 to 1,500 children rolls up impressive figures of attendance, but yields smaller educational returns than almost any other form of juvenile instruction.

The work for both children and adults is organized in the form of courses of instruction, including laboratory and field work. In particular, the work for adults is of the nature of what has come to be technically known as "adult education."

Moreover, none of the work is offered free. Here again experience has shown that where a fee is charged, however nominal, enrolment is increased, attendance and quality of work are improved, and the merely curious, incompetent and idlers are eliminated. Charging a small fee has been specially effective in the children's work. No fee is charged to classes from the public and private schools brought to the garden by their teachers for instruction by members of the garden staff.

In addition to formal instruction the Botanic Garden, like all similar institutions, maintains a bureau of free public information on all aspects of plant life and gardening, including trade services, inter-library loan service and cooperation with departments of the city government, such as the park department, the board of health, and others.

And, of course, the labeled collections of living plants serve an educational purpose, just as the exhibits in a museum do, for the plantations of a botanic garden are essentially an outdoor museum. And a botanic garden is, or should be, the common meeting ground of horticulture and of botany as distinguished from horticulture. I have elsewhere endeavored to express the distinction between botany and horticulture by noting the difference in the place of emphasis. For the botanist the garden exists for plants; for the horticulturist plants exist for the garden. The botanist, as such, is primarily interested in plants and in all plants without any reference to a garden—non-deco-

rative plants, weeds, fungi and wild plants. The horticulturist, as such, is primarily interested in the garden, and in plants as they are useful for making a garden, or have other ornamental value or economic value. Of course, the fields of botany and of horticulture overlap, as do all the sciences, and any attempt to define a hard and fast dividing line would fail; but in the older botanic gardens the main concern appeared to be to grow the plants which the botanist wished for studying and for teaching; the problem of a beautiful garden, if it existed at all, was secondary. The justly famous Chelsea Garden, near London, especially in its earlier years, is an example. The gardens of the great English estates, Japanese landscape gardens, and, in America, such gardens as the Magnolia Gardens and the Middleton Garden near Charleston are examples of horticultural (as distinguished from botanical) gardens.

The problem of the modern botanic garden is to be educational and otherwise serviceable from the standpoint of botany and, at the same time, to be as beautiful as possible *as a garden*—to combine botanical and horticultural values; to be socially serviceable. A few lantern slides will illustrate in a partial manner one attempt to realize this ideal.

(At this point a number of colored lantern slides and two reels of motion pictures in natural color were exhibited, illustrating the plantations and various aspects of the scientific and educational work of the Brooklyn Botanic Garden.)

OBITUARY

ANDREI VASSILIEVITCH MARTYNOV

NOT long ago, very little was known of the fossil insects of the vast Russian territory in Europe and Asia. Ust Balei, on the Angara River in Siberia, had produced a series of interesting forms, and I had the pleasure of collecting insects of Tertiary age on the east coast of Siberia. But no one realized that the U. S. S. R. was in fact a happy hunting ground for the paleoentomologist, comparing not unfavorably with some productive regions in western Europe and in parts of the United States. As recently as 1927 a rich deposit of Liassic age was discovered in Ferghana, and subsequent collecting brought to light a fauna which has just been recorded in a volume of 232 pages, with many illustrations, published at Moscow and Leningrad, 1937. When I received this book not many weeks ago, I thought of its author, A. V. Martynov, and recalled my meeting with him at Leningrad in 1927. I remembered his many valuable contributions to the knowledge of recent and fossil insects, and rejoiced to think that he was going on from discovery to discovery, taking advantage of the opportunities which came to him. I recalled his vivid account of his search for insects in Permian rocks; how he hunted long without success, and eventually found two concretions, of no great size, but filled with remains of insects. One could not fail to be struck by his keenness of mind, his enthusiasm, and his perseverance. In the midst of these reflections came the melancholy news that Martynov had died on January 29, from cancer.

Martynov was born in 1879 in Central Russia. He graduated from Moscow University, and became assistant professor at Warsaw in Poland. When I met him he was in the Zoological Museum of the Academy of Sciences in Leningrad, but more recently he was transferred to the newly established Institute of Paleontology of the Academy in Moscow. He had made intensive studies of the caddis-flies (Trichoptera) in the recent fauna, but he was attracted to problems having to do with the morphology and phylogeny of insects, problems which were illuminated by the many newly discovered types in Mesozoic and late Paleozoic strata. Describing very many genera and species, which often had to be referred to entirely new groups, he was not concerned so much to record a large number of novelties as to see what they all meant for the long history of insect life and the understanding of evolution in general. We may not adopt all his views, but at the very least we must recognize the permanent value and importance of his work, which will be continually referred to by all subsequent students.

T. D. A. COCKERELL

RECENT DEATHS AND MEMORIALS

DR. DANIEL WEBSTER HERING, since 1916 professor emeritus of physics at New York University, dean of the Graduate Faculty from 1902 to 1916 and curator of the James Arthur collection of timepieces, died on March 24 at the age of eighty-eight years.

DR. PERLEY ASON ROSS, professor of physics at Stanford University, died on March 20 in his fifty-fourth year.

DR. LOUIS WILLIAM STERN, professor of psychology at Duke University and prior to the recent difficulties in Germany director of the Psychological Institute at the University of Hamburg, known for his contributions to child psychology and psychological testing, died on March 27 at the age of sixty-six years.

Nature reports the following deaths: Charles Benson, formerly deputy director of the Agricultural Department, Madras, known for his work on Indian cotton and tobacco, on March 5, aged eighty-two years;

of Dr. Alfred Fischel, formerly professor of experimental embryology in the University of Vienna and editor of the *Zeitschrift für Wissenschaftliche Biologie,* aged sixty-nine years, and of Professor Friedrich von Krüger, for many years director of the Department of Physiological Chemistry in the Institute of Physiology of the University of Rostock, aged seventy-six years.

THE Edison Institute Foundation, in charge of Greenfield Village, established by Henry Ford, has announced plans for the dedication on April 16 of the home and workshop of Orville and Wilbur Wright. Orville Wright has been invited to be the guest of honor. The Wright home and the bicycle shop in which the brothers constructed the first successful airplane have been moved from Dayton, Ohio, and reconstructed in Greenfield Village and much of the original equipment has been installed. The dedication will occur on the birthday anniversary of Wilbur Wright, who was born in 1867 and died in 1912.

A SERVICE in memory of the late Lilian Welsh, professor emeritus of physiology and hygiene at Goucher College, will be held at the college on Sunday afternoon, April 3, at 4:00 P. M. Addresses will be made by: Dr. Florence Rena Sabin, member of the Rockefeller Institute for Medical Research; Dr. Margaret Shove Morriss, dean of Pembroke College, Brown University, president of the American Association of University Women; Dr. Gertrude Carman Bussey, professor of philosophy; Dr. Jessie L. King, professor of physiology; Eline von Borries, associate professor of physical education, Goucher College, and Eleanor Diggs Corner, alumna member of the Board of Trustees.

SCIENTIFIC EVENTS

PRESENTATION OF THE PHILADELPHIA AWARD TO PROFESSOR RICHARDS

As has been recorded in SCIENCE, Dr. Alfred Newton Richards, professor of pharmacology at the University of Pennsylvania, received on March 9 the Philadelphia Award, which was presented to him at the Academy of Music. The award, established by Edward W. Bok, consists of $10,000, a gold medallion and an engrossed scroll. Dr. Edwin G. Conklin, of Princeton University, executive vice-president of the American Philosophical Society, made the presentation, and the principal address was given by Waldemar B. Kaempffert, science editor of *The New York Times.* We are permitted to quote the remarks made in response by Professor Richards, which read:

The chief element of such satisfaction as I have felt since learning of what was to happen to-night lies in the fact that in this city there are scores—in this country, hundreds—of young men, who, known or unknown to me, are my colleagues and who may gain encouragement from this award. They are my colleagues in the sense that their chief interests, like mine, are centered in the experimental science of physiology—the science which strives to describe and to understand the phenomena of living things; hence, when studied in relation to man and higher animals, the mother of scientific medicine.

Their work, directed at accurate descriptions and correlations of the manifestations of life, is commonly pursued with little thought of immediate practical outcomes; but nevertheless, with profound conviction, amply justified by experience, that out of clearer understandings of the mysterious processes at work within our bodies, there must, inevitably, come in time discoveries of better methods of dealing with the ills which result from disturbances in those processes.

In the past, the Bok Committee has honored exquisite surgical technique in the service of medicine by its award to Dr. Chevalier Jackson; deep understanding of mental phenomena in relation to medicine by its award to Dr. Bond. To-night, the aim must have been, however widely the mark has been missed, to honor the sciences which contribute to medicine, the broadest and deepest of which is physiology.

I conceive it not only fitting but obligatory to acknowledge some of the debts which have been accumulating during the years, out of which have emerged the contributions with which my name may be associated.

First, to a group of younger collaborators, changing in personnel as the years have passed, whose minds and energies joined with mine in efforts to increase our insight into certain problems of the physiology of excretion concerning which we were at sea. Chance gave me the privilege of seniority in that group; chance brought us together; chance, good fortune, the questions of alert students directed us toward problems which we were able partially to solve. I welcome the bestowal of the Philadelphia award, inasmuch as it constitutes recognition by a distinguished committee of Philadelphians of the labor of those particular people for whom I have deep affection.

Acknowledgment must also be made to the school in which for so many years we have had the privilege of working. Concerted investigative efforts, when carried on in universities, are possible only in those whose administrators recognize that the obligation to contribute new knowledge is as binding as is the obligation to instruct students. The student who breathes the exhilarating air of investigation comes to realize that what he learns from the records of the past is the product of the enthusiasm of youngsters like himself, fascinated by a glimpse of the mysteries which surround him, determined to try to describe and understand them. He becomes truly a contemporary of the great ones of the past as well as of the lesser ones who are following their steps. With such thoughts as these schools like that which, for

the moment, I happen to represent have seen to it that the inquiring and curious members of their faculties and student bodies shall have the expensive time and facilities and the impetus to discharge the investigative obligation to which I have referred. It is impossible for me to regard this present award as other than distinguished approval of an enlightened policy of the authorities of the University of Pennsylvania.

And now I hope it is not out of place to mention an obligation of another sort which I should be unhappy not to acknowledge. I am thinking of a man, over eighty years old, now living on Trumbull Street in New Haven—R. H. Chittenden by name—forty years ago Yale's greatest teacher of chemistry—under whom it was my good fortune for a time to work. I think also of a small group of teachers and investigators who in New York in the first decade of this century formed an important part of that ferment from which have grown the amazing developments in this country in medical research and methods of medical education of which you have heard to-night. Two names leap to mind—they will mean little to you—much to me—Christian Herter and Graham Lusk. I should have been dull indeed had I not been able, coming to Philadelphia after association with them and their colleagues, to carry with me a little of the spirit of those courageous souls: if in some measure to-night's award can bring credit to their names I shall be happy.

With these heavy indebtednesses—with thankfulness for the generosity of Mr. Bok and for the good opinion of the committee, I accept the award with pride and in all humility.

SYMPOSIUM AT THE UNIVERSITY OF NOTRE DAME

A SYMPOSIUM will be held at the University of Notre Dame on May 2 and 3 entitled "The Physics of the Universe and the Nature of Primordial Particles."

During the meeting three public lectures will be given as follows:

Dr. Carl D. Anderson, of the California Institute of Technology: "The Basic Constituents of Matter."

Dr. Arthur H. Compton, of the University of Chicago: "Whence Cosmic Rays?"

Dr. Harlow Shapley, Harvard University: "The Distribution of Matter in the Metagalaxy."

Technical papers announced on the preliminary program are:

Carl D. Anderson, California Institute of Technology: "Some Aspects of the Cosmic-ray Problem."

Gregory Breit, University of Wisconsin: "The Nature of the Forces between Primordial Particles."

J. F. Carlson, Purdue University: "The Theory of Cosmic-ray Particles."

Arthur H. Compton, University of Chicago: "Recent Research on Cosmic Rays."

Eugene Guth, University of Notre Dame: "The Relativistic Theory of Primordial Particles."

Arthur E. Haas, University of Notre Dame: "Cosmic Constants."

William D. Harkins, University of Chicago: "The Heat of the Stars and the Building of the Atoms in the Universe."

Canon Georges Lemaître, University of Louvain, visiting professor at the University of Notre Dame: "The Problem of the Expansion of the Universe."

Manuel S. Vallarta, the Massachusetts Institute of Technology: "The Influence of the Magnetic Field of the Earth on Cosmic-ray Particles."

AWARD OF THE LAETARE MEDAL

THE Laetare Medal, conferred annually by the University of Notre Dame on "an outstanding member of the Catholic laity," has been awarded to Dr. Irvin Abell, of Louisville, president-elect of the American Medical Association. In making the announcement of the award the Rev. John F. O'Hara, chairman of the Laetare Medal Committee, said:

The merit of Dr. Abell in his profession has been signally recognized in his election to the presidency of the American Medical Association, and his varied service to city and state and nation, as surgeon, citizen, soldier and Christian gentleman, has endeared him in the esteem of a numerous and extensive public benefited by his years of devotion to the complete welfare of his fellow men. Most significant, perhaps, among the achievements of this eminent man of medicine is his contribution to the difficult science of psychiatry and his efficient effort toward the cure and prevention of mental disorder.

Dr. Abell was born in 1876, in Lebanon, Ky. He is a descendant of a family that originally settled in Kentucky in 1788. He was graduated from St. Mary's College, Kentucky, in 1892 and five years later took his degree in medicine from the Medical School of the University of Louisville, where he has been professor of clinical surgery since 1904. Dr. Abell studied at the University of Marburg and at the University of Berlin. He was lieutenant-colonel in the United States Army Medical Corps during the world war and is now a colonel in the Medical Reserve Corps.

The Laetare Medal award originated in the ancient papal custom of bestowing the Golden Rose on a member of the Italian Catholic nobility on Laetare Sunday. Its modern counterpart was inaugurated at Notre Dame in 1883, when the Very Rev. Edward Sorin, C.S.C., university founder, bestowed the first medal on the late John Gilmay Shea, the Catholic historian. Dr. Abell is the fifty-sixth recipient of the award.

ELECTION OF FELLOWS OF THE ROYAL SOCIETY, LONDON

AT the annual election of fellows of the Royal Society held on March 17, the following were elected:

G. D. Bengough, consultant to the Chemical Research Laboratory, Department of Scientific and Industrial Research.

C. H. Best, professor of physiology, University of Toronto.

W. Brown, professor of plant pathology, Imperial College of Science and Technology.

J. W. Cook, professor of chemistry, the Research Institute, Royal Cancer Hospital.

T. L. Eckersley, research physicist, Marconi's Wireless Telegraph Company.

G. I. Finch, professor of applied physical chemistry, Imperial College of Science and Technology.

W. E. Gye, director of the laboratories of the Imperial Cancer Research Fund.

W. V. D. Hodge, Lowndean professor of astronomy and geometry, University of Cambridge.

J. S. Huxley, secretary of the Zoological Society of London.

J. Jackson, H.M. astronomer at the Cape.

Sir Robert Mond, chemist and Egyptologist.

J. E. Richey, district surveyor, H.M. Geological Survey.

F. S. Russell, naturalist at the Marine Biological Association.

B. F. J. Schonland, professor of physics, University of Cape Town.

F. S. Sinnatt, director of fuel research, Department of Scientific and Industrial Research.

K. M. Smith, senior research assistant, Plant Virus Station, Cambridge.

E. Stedman, lecturer in department of chemistry in relation to medicine, University of Edinburgh.

C. E. Tilley, professor of mineralogy and petrology, University of Cambridge.

W. E. S. Turner, professor of glass technology, University of Sheffield.

H. H. Woollard, professor of anatomy, University College, London.

THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

THE Federation of American Societies for Experimental Biology will meet in Baltimore on March 30 and 31 and April 1 and 2. The federation is composed of the American Physiological Society, the American Society of Biochemists, the American Society for Pharmacology and Experimental Therapeutics and the American Society for Experimental Pathology.

This annual meeting will be unique in that it will celebrate the fiftieth anniversary of the founding of the American Physiological Society. The addresses at the banquet will be devoted to commemorating the work of the three men who organized the society and directed the first three physiological laboratories in the country. Dr. Walter B. Cannon, of Harvard University, will speak on Henry P. Bowditch; Dr. Anton J. Carlson, of the University of Chicago, on S. Weir Mitchell, and Dr. William H. Howell, of the Johns Hopkins University, on H. Newell Martin. Dr. Walter E. Garrey, president of the society, will introduce Dr. William T. Porter, honorary president, who will act as toastmaster.

All the original members of the society now living, together with the past presidents, representatives of other biological societies in this country and of the English and Canadian physiological societies, are expected to attend as guests. To further commemorate the occasion an illustrated history of the American Physiological Society is in process of publication. It will contain articles by William H. Howell and Charles W. Greene, with a foreword by Walter J. Meek.

SCIENTIFIC NOTES AND NEWS

DR. H. C. CHRISTENSEN, secretary of the National Association of Boards of Pharmacy, has been awarded the Remington Medal for 1938. The presentation will be made at a coming meeting of the New York Branch of the American Pharmaceutical Association. The medal is awarded annually to the "man or woman who has done most for American pharmacy during the preceding year or during a longer period of outstanding activity and of fruitful achievement."

PROFESSOR F. E. TURNEAURE, dean emeritus of the College of Engineering of the University of Wisconsin, and Dr. D. W. Mead, professor emeritus of hydraulic and sanitary engineering, were presented with honorary memberships in the Engineering Society of Wisconsin at the annual convention, which was held from March 17 to 19. At a banquet in the evening of March 17 the speakers were: President C. A. Dykstra, Colonel E. E. Gesler and C. R. Martin, of Milwaukee.

DR. ROSS G. HARRISON, Sterling professor of biology at Yale University, has been elected a foreign member of the Zoological Society of London.

DR. GEORGE B. BARBOUR, associate professor of geology in the Graduate School of Arts and Sciences of the University of Cincinnati, has been elected an honorary member of the Geological Society of Belgium.

AN honorary degree will be conferred on Dr. Harry Steenbock, professor of agricultural chemistry at the University of Wisconsin, at the eighty-fifth commencement exercises of the university on June 20.

THE honorary membership of the Rittenhouse Astronomical Society of Philadelphia was conferred upon Dr. Knut Lundmark, director of the observatory at the University of Lund, Sweden, at a joint meeting of the society with the Franklin Institute on March 24. Dr. John H. Pitman, of the Sproul Observatory, president

of the Rittenhouse Society, made the award, which was given in recognition of Dr. Lundmark's "important contributions to astronomy, particularly in his investigations on the objects of outer space." Astronomers upon whom honorary membership had previously been conferred are: Dr. Frank Schlesinger, Dr. Robert G. Aitken, Dr. Harlow Shapley, Robert R. McMath and Dr. Armin O. Leuschner.

DR. ROBERT W. HODGSON, professor of subtropical horticulture in the College of Agriculture of the University of California at Los Angeles, has received the decoration of Officier du Mérite agricole, France, in recognition of professional services in the horticultural development of French North Africa in 1930 and 1931, and for advice since that period. He spent a year conducting horticultural surveys for the French protectorate governments of Tunisia and Morocco.

THE thirty-fifth anniversary of Dr. Smith Ely Jelliffe's editorship of *The Journal of Nervous and Mental Diseases* will be celebrated at the New York Academy of Medicine on April 22. The celebration will consist of a Neuro-Psychiatric Symposium to be held on the afternoon of April 22 at two o'clock, and will be followed by a dinner in the evening. Speakers at the dinner, who will pay tribute to Dr. Jelliffe, are: Earl D. Bond, who will speak on "Balance in Psychiatric Research"; George Draper, on "The Man Factor in Disease"; Frederick Tilney, on a "New Interpretation of the Hippocampus"; Oskar Diethelm, on "Psychiatry and Neurology in the Last Fifty Years," and Karl A. Menninger, on "Somatic Correlations with the Unconscious Repudiation of Femininity in Women."

A. E. COLLINS, assistant to the president of the International Nickel Company of Canada, has assumed the presidency of the Canadian Institute of Mining and Metallurgy for the 1938–1939 term. He succeeds the Honorable Michael Dwyer, Minister of Mines for Nova Scotia.

DR. HERBERT V. NEAL, professor of zoology and dean of the Graduate School of Tufts College, will retire at the end of the academic year. He joined the faculty of the college in 1913.

DR. GEORGE W. MCCOY, medical director of the U. S. Public Health Service, at the request of Dean Rigney D'Aunoy has been assigned by Dr. Thomas Parran, Jr., surgeon-general of the United States, to the School of Medicine of the Louisiana State University. His title will be professor of preventive medicine and public health.

MAJOR THOMAS D. STAMPS, of the U. S. Corps of Engineers, has been nominated by President Roosevelt to be professor of civil and military engineering at the U. S. Military Academy, at West Point, N. Y.

DOUGLAS F. MINER, manager of the Central Engineering Laboratories and Standards of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, has been appointed George Westinghouse professor of engineering at the Carnegie Institute of Technology. He will act as coordinator for the Westinghouse cooperative engineering plan, under which a qualified group of engineering students will take the usual technical college course, and during the same period will receive shop and engineering experience at the Westinghouse plant. Students may follow any of the engineering courses given at the institute. The professorship is part of the plan announced last autumn when the Westinghouse Company gave $200,000 to the endowment fund of the institute. Ten scholarships are also provided annually for exceptional students, who over a period of five years will receive the sum of $3,000.

AT the University of Chicago, Dr. Alfred L. Kroeber, professor of anthropology at the University of California, has been appointed visiting professor for the spring quarter in anthropology. In addition to his courses on "The Nature of Culture" and "Primitive Art," he will give a series of public lectures. Dr. Robert Petrie Walton, professor of pharmacology at the University of Mississippi, will be a visiting lecturer in pharmacology. Dr. Wilton Marion Krogman, of Western Reserve University, has been appointed associate professor of anatomy and physical anthropology.

DR. R. V. CHRISTIE, until last September a member of the Medical Clinic of McGill University, previously of the Hospital of the Rockefeller Institute of New York City, has been appointed to the university chair of medicine at St. Bartholomew's Hospital Medical College, London.

DR. COLIN G. FINK, professor of electrochemistry, Columbia University, has been appointed an official American delegate to the thirteenth Conference of the International Union of Chemistry and the tenth International Congress of Chemistry to be held at Rome from May 15 to 21. He will deliver an address on "The Electrochemistry of the Rare Metals."

DR. A. J. NICHOLSON, chief of the Division of Entomology of the Australian Council for Scientific and Industrial Research, Canberra, has arrived in the United States and is working in the laboratory of Professor Harry S. Smith at the University of California Citrus Experiment Station at Riverside. Dr. Nicholson is known for his work on growth and balance in animal populations. Dr. and Mrs. Nicholson expect to spend five weeks at Riverside, after which they plan to visit eastern United States, Canada, En-

gland, Germany and various other European countries, returning to Australia *via* the east coast of Africa.

DR. EUGENE DAVENPORT, dean emeritus and first director of the Experiment Station of the College of Agriculture of the University of Illinois, and H. W. Mumford, the present director, were the principal speakers at the celebration of the fiftieth anniversary of the station on March 25.

PROFESSOR A. N. WINCHELL, of the University of Wisconsin, delivered the third series of Grant Memorial Lectures at Northwestern University on March 30, 31 and April 1. On the evening of March 31 he gave a non-technical lecture entitled "Where Art and Science Meet" and on three successive afternoons a series of technical lectures on "The Nature of Crystal Structure."

THE fifty-sixth course of the Lane Popular Medical Lectures will be given at Stanford University during April and May. There will be four lectures on Friday evenings, beginning on April 1. The lecturers are: Dr. Walter W. Boardman, Dr. Donald E. King, Dr. William J. Kerr and Dr. Dwight L. Wilbur.

DR. WALLACE M. YATER, professor of medicine in the School of Medicine of Georgetown University, delivered the annual Kober Lecture at the university on March 28. The lecture was entitled: "Goiter and the Heart: An Exposition of the Present Status of Our Knowledge of the Subject."

DR. EDISON PETTIT, astronomer in the Mt. Wilson Observatory of the Carnegie Institution of Washington, on March 16 gave at the University of California at Los Angeles a lecture on solar prominences illustrated by motion pictures recently secured with the tower telescope of the McMath-Hulbert Observatory of the University of Michigan at Lake Angelus. Dr. Pettit was accompanied by Robert R. McMath, the director of the McMath-Hulbert Observatory, who made a few informal remarks after the lecture.

DR. DAVID KENNEDY HENDERSON, professor of psychiatry in the University of Edinburgh, physician superintendent of the Royal Edinburgh Hospital for Mental Disorders, will deliver the sixth series of the Thomas William Salmon Memorial Lectures at the New York Academy of Medicine on April 18, 19 and 20.

DR. FRANCIS G. BENEDICT, research associate of the Carnegie Institution of Washington and formerly director of the Nutrition Laboratory of the Carnegie Institution in Boston, gave addresses from March 2 to 18 under the auspices of Sigma Xi on the subject, "Animal Metabolism from the Mouse to the Elephant," at the following institutions: The Ohio State University, the Michigan State College, the College of Medicine of the University of Illinois, Chicago; the University of Colorado, the University of Washington and Purdue University. In many cases he also spoke informally on "What the Research Worker may Learn from the Magician."

THE American Psychological Association will hold its forty-sixth annual meeting at the Ohio State University from September 5 to 10. Officers this year are: *President,* J. F. Dashiell, University of North Carolina; *Secretary,* Willard C. Olson, University of Michigan; *Treasurer,* Willard L. Valentine, the Ohio State University. Arrangements for the convention are in the hands of a committee consisting of the president and secretary of the association and Dr. H. E. Burtt, of the department of psychology. Numerous subcommittees are in charge of convention details. The Society for the Psychological Study of Social Issues, the Psychological Corporation, the Psychometric Society and the American Association of Applied Psychologists will meet in conjunction with the association.

THE ninth spring meeting of the Eastern Branch of the American Psychological Association will be held under the auspices of New York University on Friday, April 1, at the Hotel Commodore, New York City, and on Saturday, April 2, at the University College of Arts at University Heights. A banquet will be held at 7 o'clock on the evening of April 1, after which Professor Karl S. Lashley, of Harvard University, will give the presidential address. He will speak on the "Experimental Analysis of Instinctive Behavior."

THE governor of Alabama has announced that the Rockefeller and Carnegie Foundations will provide an endowment of $10,000,000 for construction of a medical center at Tuscaloosa in conjunction with the University of Alabama and the state mental hospitals. It will provide a four-year medical school for the university, a general hospital, a psychopathic hospital, nurses' school and state-wide clinics.

AN allotment of $90,525 has been made by the Works Progress Administration for the running of geodetic surveys throughout the State of Louisiana and in establishing permanent bench marks. The headquarters of the survey will be in New Orleans.

PRELIMINARY arrangements have been made recently with officials of the U. S. Biological Survey for the collection of stream flow records by the Geological Survey at three of the Migratory Waterfowl Refuge projects where information relating to the water supplies is essential in connection with their operation. These projects are in South Dakota, Oregon and Michigan.

THE Florida Academy of Sciences is interested in entering into exchange arrangements with scientific

periodicals published anywhere in the world. Volume I (1936) of the proceedings has just appeared. Any communications and copies of proceedings for exchange should be sent to Dr. J. H. Kusner, secretary, Florida Academy of Sciences, University of Florida, Gainesville, Florida.

DISCUSSION

SHOCK DISEASE AND THE SNOWSHOE HARE CYCLE

THE periodic decimation of the snowshoe hare in North America, which approximately every ten years reduces the numbers of these animals to scarcity, seems again to have run its course in Minnesota. For several years past hares have decreased in numbers throughout the state, and in most areas appear to be near or at the extreme low point. On the Lake Alexander Area in Morrison County, where extensive field and laboratory studies have been carried on since 1930, a peak population of hares was reached in 1933, when the trapping census showed 478 hares per square mile. The decline has been continuous since that time, but the greatest drop occurred during the fall and winter of 1935, so that by the spring of 1936 the population was reduced to 164 hares per square mile. Now in the fall of 1937 the numbers are so low that any enumeration will be difficult.

It has been the finding of the Minnesota Wildlife Disease Investigation,[1] from intensive studies on the Lake Alexander hare population and from supporting investigations on hare samplings throughout the state of Minnesota, that the die-off of snowshoe hares is due to a new disease entity in that species which we have called "shock disease."[2]

Hares suffering from shock disease appear perfectly normal until they are suddenly stricken with convulsions and die in the seizures or abruptly sink into a fatal coma. We first used the term "shock disease" when we recognized that some hares trapped and held in capitivity would die from the shock of change in environment. Later we learned that the convulsive seizures in these animals were hypoglycemic in character and that death was usually due to an abnormally low blood sugar.

So far as we have been able to determine, the basis of the disease is a degeneration of the liver. Usually in advanced cases the liver is a dark mahogany in color and is atrophic and definitely smaller than normal, so that the capsule is separated from the parenchyma and lies as a wrinkled membrane over the surface of the organ. Microscopically, the liver cords are highly atrophic. Thus far we have recognized consistent changes only in the liver; pathological findings in other organs are variable.

The liver degeneration is associated with a failure to store glycogen. When the carbohydrate reserve in the liver reaches a low value, the hare leads a precarious existence. As excitement or exertion depletes the small glycogen reserve, the blood sugar drops below the normal range, unconsciousness supervenes, and the hare dies. Routine technical procedures have shown that normal hares have an average liver glycogen value of 5.5 per cent., while hares in shock have values from 0.02 per cent. to 0.18 per cent.

Our first investigations of this disease in live hares were confined to animals found sick in box traps and dying, as a rule, while being taken to the laboratory. When it was recognized that the condition was so widespread that large numbers of hares died when subjected to the mild but continuous strain of captivity, intensive investigations were carried out on captive groups. During March, 1936, just at the end of the period of sharpest decline, we held 204 hares under observation. The animals survived an average of only 4.2 days, and not a single hare survived the 20th day. The conditions of captivity were favorable for extended survival as the food and surroundings were identical with those provided for groups of hares held under observation indefinitely, previous to the widespread occurrence of shock disease in the hare population. The hares appeared at ease, hopped around interestedly, and ate a variety of foods. However, a hare appearing normal would suddenly spring into the air in convulsions or sink to the floor in coma. In either case, death usually followed from a few minutes to an hour after the onset of symptoms.

This type of sudden death of hares was observed in the woods under entirely natural conditions by our staff at the same time, and similar occurrences were reported to us by others. During the summer of 1936, with the assistance of Deane Mather, of the U. S. Forest Service, shock disease was demonstrated to occur in hares 6 weeks old while living in a wild state in fenced natural ranges in which they were born. It has become evident that the death of hares which we have observed in captivity is a process which has been accelerated, but which is otherwise identical with that involving the animals undisturbed in the wild.

The large groups of hares which we have held in captivity while observing deaths from shock disease represented samples from central Minnesota, northeastern Minnesota and the northwest area lying south

[1] Executive Reports of the "Minnesota Wildlife Disease Investigation," Vol. 1 (July, 1933, to December, 1934), and Vol. 2 (January, 1935, to June, 1936). Mimeographed by U. S. Department of Agriculture.

[2] R. G. Green and C. L. Larson, *Am. Jour. Physiol.*, 119: 319–320. 1937.

of Lake of the Woods. The hare populations in these regions were afflicted with shock disease to varying degrees. Since animals from these districts rapidly succumbed to shock disease in captivity, and hares were dying from the same disease in the wild, there would seem to be no doubt that the hare population throughout Minnesota was in a process of destruction from shock disease during the winter and spring of 1936. The evidence that shock disease is almost wholly responsible for the decimation of hares is greatly augmented by our extensive attempts to demonstrate a significant mortality from other diseases which might be a factor in the area of the die-off. Such infectious diseases as tularemia we have found to play but a minor role in the mortality of hares. Moreover, the general picture of the decline, continuing until populations are extremely low, is not one typical of the course of an epizootic disease. In the sphere of our investigations both positive and negative findings point to shock disease as the primary cause of the periodic decimation of the snowshoe hare.

ROBERT G. GREEN

UNIVERSITY OF MINNESOTA

CARL L. LARSON

BUREAU OF BIOLOGICAL SURVEY

PRODUCTION OF WHEALS IN THE HUMAN SKIN[1]

UNPUBLISHED data of Abramson, Sookne and Moyer have indicated that there is in ragweed extract an active amphoteric constituent of high molecular weight which is negatively charged at pH 7.4. We have therefore attempted to elicit allergic wheals by the electrophoresis of ragweed extracts from absorbent cotton into the skin of individuals hypersensitive to aqueous extracts of ragweed pollen. It was discovered that wheals were obtained after five to ten minutes with current densities of 0.3 to 0.5 milliampere not only with the negative pole but also with the positive pole used in the same fashion. Large wheals with pseudopods were obtained following electrophoresis of dialyzed extracts. The same technique employed on subjects not hypersensitive to ragweed did not result in whealing. To account for the fact that the positive pole gave as large if not larger wheals than the negative pole, we may hypothesize either the presence of positively charged active constituents, or invoke the notion that the positively charged water molecules which set up an electro-osmotic stream through the pores of the skin may be responsible. Similar results have been obtained using extracts from the pollen of timothy grass. In unpublished experiments with Lubkin, it has been shown that positively charged histamine ions can be electrically transported from the skin from wheals produced by histamine by application of the negative electrode. Prior to the formation of an allergic wheal by means of the electrophoresis of pollen extract using the negative pole, the formation of histamine is the generally accepted theory. It should then be possible to remove the histamine from an allergic wheal by applying the negative pole. A recovery of histamine in this fashion has not as yet been achieved.

Similar experiments on the electrophoresis of insulin through the skin are in progress.

HAROLD A. ABRAMSON

[1] From the Medical Service of Dr. George Baehr and the Laboratories of the Mount Sinai Hospital, New York City.

SAUROPOD DINOSAUR REMAINS IN THE UPPER CRETACEOUS

AN expedition from the Smithsonian Institution working in the Wasatch Plateau region of central Utah during the summer of 1937 made a discovery of more than ordinary interest. In the type section of the North Horn formation, in Emery County, a considerable portion of a very large sauropod dinosaur was found in beds carrying horned (Ceratopsian) and duck-billed (Hadrosaurian) dinosaur remains. These animals fully indicate the Upper Cretaceous age of the lower eight hundred feet of the North Horn formation.

The Sauropod specimen is of special interest not only because of its unexpected appearance here, but also because it pertains to the family Titanosauridae, the first recognized occurrence of this family in North America. At this time only a scapula and a section from the mid-caudal region has been prepared, but the latter are sufficient to show the caudal vertebrae to be procoelus with small neural arches confined to the anterior half of the centra, both typical features of the family as known at the present time.

The genus *Titanosaurus* was established by Lydekker on caudal vertebrae from the Upper Cretaceous (Lamenta Beds) of India, and the same authority was the first to report the genus from the Upper Cretaceous of Patagonia.

The specimen under discussion has not been sufficiently prepared as yet for proper comparison with the type of *Alamosaurus sanjuanensis,* from the Upper Cretaceous (Ojo Alamo) of New Mexico, but such comparisons as have been possible appear to show its affinities to be near, if not belonging to that genus.

It should be recalled that *Alamosaurus* was the first sauropod dinosaur to be recognized from the Upper Cretaceous of North America, and the skepticism with which that announcement was received may now be dissipated by this second discovery under circumstances that are even more convincing than the first, if that is necessary.

This specimen will be fully described and discussed as soon as the bones have been prepared for study.

C. W. GILMORE

SMITHSONIAN INSTITUTION

A NEW RECORD FOR FRESH-WATER MEDUSAE IN PENNSYLVANIA

ON August 17, 1937, a single specimen of fresh-water medusa was brought to the writer for identification. In the afternoon of this day approximately 150 jellyfish were collected in an abandoned limestone quarry filled with spring and drainage water, near the village of Almedia, Columbia County, Pennsylvania. This collection, made with a dip net from the shore, was a small part of the population seen. Collections were made at regular intervals until October 25. Residents of the neighborhood who use this pool for bathing report that these animals were noticed several weeks previous to August 17. During this period the density of population varied from several dozen to many thousands. At the height of population density they welled up from the depth of the pool in cloud-like multitudes. This pool is 225 feet wide, 375 feet long, 35 to 90 feet deep, with very abrupt slopes.

The medusae collected in the field ranged from 0.5 mm to 18.0 mm in diameter. No hydroid forms were observed. Live medusae taken to the laboratory survived about four weeks in aquaria supplied with water and Elodea from their natural habitat. The contents of one aquarium in which the medusae had died and disintegrated suddenly became populated with minute medusae and small green hydra. This aquarium had been frequently observed with the hope that the hydroid form might have been brought in on the Elodea. The smallest of these medusae was 0.35 mm in diameter, had eight buds for tentacles, a short manubrium and well-developed velum. Specimens 0.75 mm to 1.00 mm in diameter developed 16 or more tentacles. It is estimated that a total of 250 small medusae were produced in this aquarium during a period of 28 days with a peak population of 100 specimens. Approximately half of these specimens were preserved. Some of the others were isolated with the hope that they might develop to maturity, but without success.

According to Professor Payne these medusae are *Craspedacusta ryderi.*

This is the first locality record for Craspedacusta in this section of Pennsylvania.

KIMBER C. KUSTER

STATE TEACHERS COLLEGE,
BLOOMSBURG, PA.

NEW EXPOSURES OF ORDOVICIAN BENTONITE IN SOUTHWESTERN VIRGINIA

SEVERAL excellent exposures of bentonite have been uncovered by recent road-building activities on Virginia Highway 64 in Turkey Cove, northeastern Lee County, Virginia. The bentonite beds, which vary in thickness from three inches to two feet, occur in the Lowville and Trenton formations (Middle Ordovician). The rocks have been folded and faulted so that the same bed is exposed more than once. When the writer left the area in early September, 1937, seven exposures at three horizons had already been laid open. Road-building was not complete at that time, however, and new cuts will be made in Lowville and Trenton rocks for another mile or more. Hence it is likely that ten or a dozen sections of bentonite will be available for study by the next field season. The susceptibility of the soft volcanic ash to weathering and relatively rapid removal lends especial interest to these fresh exposures.

In a recent paper on the stratigraphy of Ordovician bentonites in southwestern Virginia, Rosenkrans[1] states that the exposures of bentonite in Lee County are poor, and at the same time that the area is one of great importance in establishing by means of bentonite the stratigraphic relations of the Lowville formation in Tennessee, Kentucky and Virginia. This is the case because the sediments of Lowville age in this area are apparently transitional between the limestone deposits of the interior and the clastic rocks in the eastern part of the Appalachian Valley. The bentonite sections newly exposed in Turkey Cove fill the need expressed by Rosenkrans. It is hoped that they will receive the detailed study to which their excellence and strategic position entitle them.

ROBERT L. BATES

STATE UNIVERSITY OF IOWA

SCIENTIFIC BOOKS

GENERAL CATALOGUE OF STARS

General Catalogue of 33,342 Stars. By BENJAMIN BOSS. Carnegie Institution of Washington. 5 vols. Quarto.

THIS publication represents the final five volumes of a general program of work started by Professor Lewis Boss about the time he became director of the Dudley Observatory at Albany, sixty years ago. Professor Boss's first catalogue of standard stars was published in 1877, and his "Catalogue of 627 Principal Standard Stars, distributed from the north to the south pole and derived from a homogeneous treatment of all available

[1] R. R. Rosenkrans, *Va. Geol. Survey Bull.*, 46–I: 99, 1936.

material" appeared in 1903. This latter work was aided by the first of a series of grants from the Carnegie Institution of Washington, and these grants became a continuing fund when in 1905 the trustees of the Institution created a Department of Meridian Astrometry, cooperating with the Dudley Observatory, and with Professor Boss as director.

Under this arrangement the "Preliminary General Catalogue" (P.G.C.) of 6,188 stars, foreshadowing the "General Catalogue" (G.C.) of to-day, was developed and published by 1910. The positions of over 11,000 stars observed at Albany prior to 1901 were reduced and published by 1918. Additional observations of all stars to be in the projected catalogue were made with the meridian circle of the Dudley Observatory, the positions of 15,333 stars, observed at San Luis in the southern hemisphere from 1909 to 1911, being reduced and published by 1928, and the positions of 20,811 stars observed at Albany from 1907 to 1918, being reduced and published by 1931. And by combining this new material with all other available material of the past and present, there was throughout the gradual development of the great catalogue, just distributed, which gives definitive positions and proper motions for all stars in the sky to the seventh magnitude and for thousands of fainter stars.

The work was carried on under the direction of Professor Lewis Boss until his death in October, 1912, and since then it has been brought to a successful conclusion under the direction of Professor Benjamin Boss. Among the assistants of long connection with the work may be mentioned Mr. Roy and Mr. Varnum, both of whom carried on responsible portions of the work for over 40 years.

A general catalogue of stars is one that gives positions and motions of stars founded upon the combined results of all the principal observational catalogues available—these catalogues being reduced uniformly with the same general reduction constants depending upon the elements of the solar system and positions of the fundamental planes of reference. Professor Lewis Boss held that a standard catalogue must represent as consistently as possible the sum total of observations having fundamental value such that the sum of the squares of the deviations of the several component star catalogues at various epochs from the standard catalogues shall be a minimum. Inherently such catalogues are old before they appear. They are most accurate at their mean epoch, which in the present case is about 1900.

The publication is in five volumes, averaging 350 pages each. The first volume gives the introduction, ephemerides of 610 circumpolar stars and systematic corrections for 238 observational catalogues. The other four volumes—one for each fourth of the sky—give the positions and proper motions for 1950 of 33,342 stars.

The general arrangement and treatment of the subject-matter and the printing features are excellent.

The introduction gives a brief history of the work and explains the methods used in determining corrections to the system of the P.G.C. which was used as the provisional system for comparison. The periodic and progressive errors are thoroughly investigated, using about one hundred of the principal observational catalogues of the last one hundred years. The well-known periodic errors in the right ascensions were found to vary with the epoch. It is definitely stated that the P.G.C. system uncorrected for these periodic errors was adopted as the basis of the new system. The G.C., therefore, does not represent the observations in this respect. As these errors enter into the proper motions, also, the error of the positions will increase with time, as is shown in the large differences from the new "Dritter Fundamentalkatalog" (F.K.3), by A. Kopff.

The important correction to the declinations varying with declination was carefully determined, following the method of Professor Lewis Boss by intercomparison of observations taken at observatories in the northern and southern hemispheres with a general discussion of the refraction. This principle involves the instrumental spacing of the 180° from pole to pole as fundamental points. Other investigators make use of a third fundamental point half way between the two poles given by observations of the sun and planets. Modern observations furnish reliable positions of the equator among the stars, giving a correction of $+0''.2$ to the declinations of the G.C.

The equinox was corrected and the finally adopted corrections to the P.G.C. are given together with systematic corrections and weights for 238 observational catalogues, 1750–1925, from which positions were taken in constructing the final catalogue. The comparison with the catalogue FK3 shows larger differences than might be expected. These two outstanding catalogues—the two general fundamental investigations of this half of the century—using quite largely the same observational material from 1750 to 1925, have systematic differences at various points of the sky amounting to $0''.5$ at 1950 and increasing to $1''.0$ at the end of the century. Statistical investigators and others should bear this in mind and not confuse systematic errors with stellar motions.

In the catalogue the use of the Draper numbers instead of the conventional historic names or Durchmusterung numbers, is an innovation. Data are given so that observations in the future may be added, thus increasing the accuracy of the positions and motions of individual stars.

The probable error of a catalogue position for a fundamental star is less than 0".1. For two thirds of the stars including the fainter stars in general the probable error of the 1950 position is 0".3 or larger. The authors call attention to the need for reobservation of the larger part of the stars. They also suggest that many stars should be added to the list for the more uniform spacing required in photographic work.

One of the many valuable results of this work is that it makes possible the reduction of all star observations of the last two centuries on a uniform system.

The very large number of definitive proper motions all on a uniform basis will be of special value in many researches, and the catalogue will immediately meet a need in a wide field of statistical and positional investigations.

All those who have taken part in this production are to be heartily congratulated for a most excellent astrometric history of the brighter stars. The work is by far the most comprehensive and important of its kind ever undertaken, and it is a worthy monument to the genius and foresightedness of Professor Lewis Boss; to the zeal and ability of Professor Benjamin Boss and his collaborators; and to the generous support for over thirty years by the trustees of the Carnegie Institution of Washington.

H. R. MORGAN

QUANTUM MECHANICS

Principles of Quantum Mechanics. By A. LANDÉ. xii + 115 pp. New York: Macmillan Company. 1937. $2.25.

PAULI once said regarding quantum mechanics: "In analogy to the term relativity theory one could call modern quantum theory the theory of complementarity." The concepts of the fundamentals of quantum mechanics were clarified by Heisenberg's famous paper of 1927 on the uncertainty principle and Bohr's papers (1928–1930) on atomic theory and the description of nature. Landé's book tries to carry out the program of quantum theory as a theory of complementarity systematically. The great amount of material is covered in some 100 pages with great skill. The program of the book is set forth in an excellent preface and an introductory chapter on observation and interpretation. It is followed in part I by the elementary theory of observation: the principle of complementarity. The first paragraph of this chapter deals with the analogy between mechanics and wave theory (a short remark on the history of these considerations, which started with Bernoulli and were fully developed by Hamilton, might be of interest in a future edition.) In this first part the view-points of the corpuscular and wave theory are clarified. The second part deals with the principle of uncertainty and its application to standard experiments. Classical and quantum mechanical pictures and their correlation are discussed. This leads to the third part dealing with the principle of interference and Schrödinger's equation. The following chapter is devoted to the principle of correspondence between mechanics and wave theory. The term principle of correspondence, however, is not used in the same sense as used by Bohr—asymptotic coincidence between quantum frequencies and classical frequencies—but it refers "to all analogies and asymptotic coincidences of quantum mechanics with both the classical theory of charged particles of matter and with the classical hydrodynamics of a continuous density serving as a medium for matter waves." The book closes with a short mathematical chapter on the theory of transformations and the principle of invariants.

While we have now-a-days a great number of texts available, to introduce the student to the technique of wave mechanics, this book of Landé's will be of great value to student and teacher alike for the clarification of the fundamental concepts, their logical development and the connection between the different fields of mathematical development. May we express the hope that a future edition will include also treatment of subjects omitted now, such as photo-effect, Raman effect (as a classical effect), and one of the typically wave mechanical phenomena, "the tunnel effect."

KARL LARK-HOROVITZ

PURDUE UNIVERSITY

SPECIAL ARTICLES

INHIBITION OF PARTURITION IN THE RABBIT BY THE INJECTION OF ESTROGENIC HORMONE

THE corpus luteum is essential to the maintenance of pregnancy in the rabbit. It has been shown that parturition can be delayed and in many cases prevented for a considerable length of time if new corpora lutea are induced in the ovaries in the latter part of pregnancy by the injection of a suitable gonadotropic hormone, or if an active corpus luteum extract or progesterone, the pure corpus luteum hormone, are injected daily beginning a few days before term. It is well known that delivery occurs within 48 hours following removal of the ovaries at any time from the 20th to the 28th day of pregnancy. (Removal prior to the 20th day results usually in resorption rather than premature delivery of the foetuses.) One supposes, therefore, that in this species parturition is precipated,

in part at least, by the decline of the corpus luteum.

In an earlier note to SCIENCE (84: 161, 1936) we reported that the injection of an estrogen during the latter part of pseudopregnancy causes the corpora to persist in a functional manner. In view of the supposition that the corpora become non-functional shortly before parturition, we have carried out a series of experiments designed to test the effect of an estrogen given during the last few days of pregnancy, expecting, of course, that if its effect on the corpora be similar to that obtained during pseudopregnancy, the corpora of pregnancy would be maintained and parturition would be delayed. The results have shown this to be so. Daily injections of estradiol monobenzoate (Progynon-B) in doses varying from 50 to 500 i.u. per kilo beginning at any time from the 27th to the 31st day of pregnancy postponed delivery in most cases. In only one of nineteen animals did normal delivery of living foetuses occur at the usual time (32 days), and this was one in which injections were started on the 31st day. In fourteen of these animals parturition was delayed longer than 35 days. In the experiments thus far carried out the foetuses have been dead whether delivered or obtained by operation or autopsy. In no case as yet have we been able to obtain post-mature foetuses in animals in which parturition has been delayed with estrogenic hormone. They are killed within two days and are retained in utero. Animals killed on the 37th, 45th and 52nd days have shown macerated foetuses in utero and moderate-sized corpora lutea in the ovaries which microscopically looked very much like normal corpora. It will be remembered that the corpora of pregnancy look quite degenerate by the 35th day, *i.e.*, three days after normal parturition. It is also of interest that animals in which parturition has been prevented in this manner may show extreme necrosis of the uterine muscle. For instance, the animal killed on the 52nd day showed almost complete necrosis of the muscle overlying the foetuses. Delivery obviously would be impossible in such a case, but this can scarcely be considered the cause of the original delay in parturition, since animals in which the uteri were examined sooner showed less necrosis, and an animal subjected to laparotomy on the 32nd day showed no evidence of necrosis although the foetuses were already dead.

Control experiments have been made which indicate that the ovaries must be present if delay in parturition is to be obtained by the injection of estrogenic hormone. Four animals were castrated on the 27th day and injections of estradiol monobenzoate started the same day. Delivery occurred spontaneously on the 29th and 30th days, and living foetuses were present in all the litters. In three other animals the procedure was modified somewhat. Injections were started on the 29th and 30th days and the ovaries were removed three to five days later. All three animals delivered dead, macerated foetuses within three days after castration.

Our results show that the hormonic conditions present at the end of pregnancy may be altered in much the same manner as those at the end of pseudopregnancy. In each case the regression of the corpora is prevented by increasing the estrogen level. This indicates that there is normally no rise in the estrogen level at the end of pregnancy, as suggested by some authors.

The results which we have obtained call for an interpretation of the effect of estrogenic hormone in pregnancy in the rabbit different from that usually advanced. There are numerous references in the literature indicating that estrogens induce abortion. It has been shown that in the last third of pregnancy in the rabbit injection for only a day or two of estrogen results in premature delivery of dead foetuses within three or four days. We have obtained similar results by giving the hormone in single doses or for a limited time, but when repeated doses are given, the foetuses are retained. The explanation usually given for the abortive action of estrogen in pregnancy is that it increases the irritability of the uterine muscle to such an extent that expulsion of the foetuses takes place. Our findings suggest a different explanation. Under normal circumstances the corpora lutea are caused to remain functional during the latter half of pregnancy by some hormone elaborated by the placentas or foetuses (the presence of such a hormone has been demonstrated) but when an estrogen is given for a limited time, the placentas and foetuses are so damaged that they are no longer capable of maintaining the corpora. When the inhibiting effect of the corpus luteum hormone is removed, premature delivery of dead foetuses occurs, a result similar to that which follows castration, excepting that in the latter case the foetuses are usually living. When repeated, daily injections of an estrogen are given, as in our experiments, the placentas are injured in the same way and the foetuses die, but the corpora are maintained by the estrogen and as a result the foetuses are retained in utero.

GEORGE P. HECKEL
WILLARD M. ALLEN
SCHOOL OF MEDICINE AND DENTISTRY,
UNIVERSITY OF ROCHESTER

LOCALIZATION OF CALCIUM IN PARAMECIUM CAUDATUM

IN a series of preliminary microincineration experiments (unpublished) on the liver and brain of

young and old rats, the writer observed an increase with age in the quantity of cortical ash in the individual cells. Scott,[1] using the microincineration technique, observed a concentration of ash at both the nuclear and cell membranes. The following experiments were conducted to determine the nature of the cortical ash with particular reference to calcium.

In using the microincineration technique as a means of localizing the calcium in metazoan cells the question might arise as to whether any calcium at the cell membrane would be intercellular or intracellular. In order to avoid this possibility, the protozoan *Paramecium caudatum* was used as the experimental organism. Paramecium also has the advantage of size; it is large and comparatively easy to work with.

Procedure

The microincineration technique as developed by Policard[2] and Scott is essentially that which was used in the following experiments. The material was fixed in Bouin's Fluid (minus the glacial acetic acid); the absolute alcohol and formalin fixative as recommended by Scott was also used. Both dioxan and alcohol dehydration were employed with no apparent variation in the results. The material was imbedded in paraffin in the usual manner and sectioned at 8 micra. The sections were mounted on clean slides and incinerated in an electric furnace at approximately 600° C., for 30 minutes. The material was then studied by means of the dark-field microscope.

Two specific colorimetric tests for calcium were used; sodium alizarin sulfonate, which produces a red precipitate in the presence of calcium,[3] and the gallo-formic reaction, which produces a blue precipitate specific for calcium.[4] The reagent as used by the writer consisted of a solution of concentrated gallic acid and 40 per cent. formaldehyde (1–1) rendered alkaline (pH 9.0) by the addition of concentrated NH_4OH. The gypsum reaction was also used to a small extent. This consists of dissolving the salt in a microdrop of $0.1N \cdot HCl$ and precipitating the typical $CaSO_4 \cdot 2H_2O$ crystal by adding a microdrop of $0.1H \cdot H_2SO_4$ (Scott).

Results

Random samples of paramecia consistently showed a heavy concentration of salts in the cortex of the cells. The cortical layer of ash was uniform in thickness throughout. A faint pink color was observed, which was imparted to the ash by the presence of iron. Occasional granules of ash were observed in the cell which were probably the inorganic remains of food granules, etc. The thickness of the outer ring of cytoplasmic ash varied considerably. While no actual measurements were done on the thickness of the layer, two distinct extremes were observed, a thin relatively smooth layer of ash on the one hand, and a heavy, granular layer on the other.

Sections treated with sodium alizarin sulfonate showed a distinct change in the color of the cortical layer of ash. The original light pink color gave way to the purplish red, which is characteristic of the alizarin reaction. However, since there does exist a general similarity between the original pink and the final red, the gallo-formic reaction was employed as a check. A bluish-violet color in the cortical ring confirmed the alizarin test for calcium. As previously stated, the gypsum reaction was employed to a small extent. The writer found that the colorimetric methods were sufficiently more positive to warrant their exclusive use. Actually, it was hardly necessary to test for the presence of calcium in the cortical ring of ash. Since almost all the inorganic salts were concentrated in that region of the cell, and since calcium is known to be present in the cell, it would follow that the calcium must be in the cortex. The variation in the thickness of the cortical ring of ash prompted the writer to repeat the experiment using organisms of known ages. (This investigation is being conducted at the present time.)

Summary

By means of the microincineration technique and two specific colorimetric tests for calcium, the writer has demonstrated that most of the cytoplasmic salts are concentrated in the cortex of the cell and that calcium is a constituent of the cortical ash.

Albert I. Lansing
George Washington University

[1] Scott, *Am. Jour. Anat.*, 53: 243, 1933.
[2] Policard, *Protoplasma*, 7: 464, 1929.
[3] Pollack, *Jour. Gen. Physiol.*, 11: 539, 1928.
[4] Cretin, *Bull. Am. Chem. Soc.*, 33: 1551, 1923; *Bull. Hist. Appl.*, 1: 125, 1924.

THE PRESENCE OF A TYPE- AND SPECIES-SPECIFIC CONJUGATED POLYSACCHARIDE IN TYPE I PNEUMOCOCCUS

The findings of numerous investigators have shown that each pneumococcal type elaborates a type- and a species-specific polysaccharide. They have been isolated individually and characterized chemically. Since heat, acid and alkali have been employed in their isolation, and since autolysates or highly autolyzed organisms have been used as the source of material, it has appeared probable that the polysaccharides thus isolated were fragments or modified parts of a higher complex which might be present in the young and actively growing Gram-positive organisms.

To elucidate this question the isolation of these substances was undertaken from twelve-hour cultures of Gram-positive organisms, by removing the protein from the carbohydrate solution with the chloroform method.[1] The Type I polysaccharide thus isolated produced active immunity in mice and is chemically different from those hitherto described.

The present report is an extension of the above study. To prevent enzymic autolysis strictly Gram-positive, young organisms of Type I were used. They were grown in beef broth containing catalase to remove the hydrogen peroxide produced as a metabolic product. A polysaccharide was obtained which is identical with the one previously isolated.[1] After repeated precipitation from methyl and ethyl alcohol and finally from 60 per cent. ethyl alcohol, the analysis of the polysaccharide gave 6.35 per cent. nitrogen; 2.78 per cent. phosphorus; and 23.0 per cent. reducing sugar.

Serologically, this polysaccharide in dilution of one to one million gives precipitates with monovalent horse sera of Types I, II and III. Type I serum, absorbed with purified species-specific carbohydrate "C" prepared from young Gram-positive rough pneumococci, still reacted to titer with the conjugated polysaccharide derived from Type I, but not at all with a conjugated polysaccharide derived from Type II. Similarly, a Type II serum, absorbed with "C," reacted to titer with Type II but not at all with Type I conjugated polysaccharide. This type I carbohydrate removed antibody against "C" from Type II and Type III sera, and both type and species-specific antibodies from Type I serum.

The presence of phosphorus might be attributed either to inorganic phosphorus, phosphatides or the species-specific "C" carbohydrate as a mixture or in chemical combination with the type-specific polysaccharide.

To remove any phosphatide that might be present in the polysaccharide in one form or another, the following treatments were used:

(a) The dry carbohydrate was refluxed for one hour successively with each of the following solvents: pure acetone, one to one ethyl alcohol and ethyl ether solution, benzene, followed by ethyl ether and alcohol solution, and finally with low-boiling petroleum ether. The carbohydrate was then precipitated from its water solution with two parts of 95 per cent. alcohol.

(b) The carbohydrate was refluxed on a boiling water bath for four hours in N/5 acetic acid, cooled and extracted with ethyl and petroleum ether neutralized and extracted again with the same reagents. The carbohydrate was then precipitated with two parts of 95 per cent. alcohol.

[1] M. G. Sevag, *Bioch. Zt.*, 273: 419, 1934.

The treatments (a) and (b) produced chemically and serologically no change, thus eliminating the possibility of the presence of phosphatide in this polysaccharide. Furthermore, pure "C" in a mixture with the present carbohydrate is readily removed by treatment with two parts of alcohol; therefore the present substance must contain "C" in combination with the type specific carbohydrate.

(c) To remove any inorganic phosphorus which might be present as impurity, the solution of carbohydrate was brought to pH 2.5 with glacial acetic acid and precipitated with two parts of 95 per cent. alcohol. This treatment was repeated five times. Chemically and serologically no change was produced.

(d) The aqueous solution of the polysaccharide prepared as in (C) was treated with five volumes of glacial acetic acid; no precipitate was produced. Upon subsequent treatment with 1.5 volumes of 95 per cent. alcohol and two grams of sodium acetate per 100 cc solution, it flocculated immediately. The aqueous solution of the alcohol and ether-washed precipitate containing 2.0 grams of sodium acetate per 100 cc solution was further fractionated twice with two parts of 95 per cent. alcohol.

(e) 20 cc of the acidified carbohydrate solution was treated with 2 gms of sodium acetate. It was then chilled and treated with 7 cc of chilled 95 per cent. alcohol and centrifuged. The supernatant fluid was further treated with 7 cc of chilled 95 per cent. alcohol. These treatments were repeated several times on the sediments, and the carbohydrates thus obtained were similar to the one obtained above.

These treatments resulted in no change chemically or serologically. These findings would seem to indicate that in actively growing Gram-positive pneumococcus the type- and species-specific carbohydrates exist in a combined complex form. This complex alone or in mixture with swine serum did not produce immunity in rabbits. It is therefore reasonable to assume that this new complex carbohydrate may be in an antigenically active union with a protein component in the organism as the complete antigen. Studies are in progress in this laboratory to isolate this protein-carbohydrate complex in native form.

M. G. SEVAG

UNIVERSITY OF PENNSYLVANIA

THE BITTERLING OVIPOSITOR REACTION TO CORTICOSTERONE

IN 1932 we reported that female bitterlings (*Rhodeus amarus*) show an enlargement of the ovipositor following injection of an estrogenic preparation, while physiological solution of sodium chloride and an anterior pituitary extract yielded no reaction.[1] This

[1] W. Fleischmann and S. Kann, *Pflügers Arch. f. d. ges. Physiol.*, 230: 662, 1932.

effect could also be produced by adding estrogenic preparations to the water of the aquarium inhabited by the fish.[2] This observation was confirmed by the work of several authors. (Ehrhardt und Kühn,[3] Wunder,[4] Matousek,[5] Macht and Bryan.[6]) Kanter, Bauer and Klawans[7] showed that by using standardized bitterlings the ovipositor lengthening reaction could be used for detecting excesses of estrogenic hormones in the urine of pregnant women. These findings are confirmed by recent papers (Stiasny,[8] Marcus[9]). Whilst urines of women who were neither pregnant nor suffered from any endocrine disturbance gave negative results, urine from adult males gave a positive reaction. It was suggested by Kleiner, Weisman and Mishkind,[10] that it was the male sex hormone, which caused the reaction. Barnes, Kanter and Klawans[11] tried to locate the source of the material in the urine, which caused the reaction, by means of tissue extracts. The only extracts giving a positive response came from the adrenals. Kleiner, Weisman and Mishkind[12] found that purified active extracts of adrenal cortex gave a positive reaction. They suggested that the active principle, giving the bitterling reaction, might be identical with the corticosterone isolated from the adrenal cortex by Reichstein.[13]

We are indebted to Professor Reichstein, of Zurich, for giving us 20 mg of pure corticosterone for our experiments. We found that the ovipositor reaction following the injection of pure corticosterone was very great. We dissolved 3 mg of corticosterone in 0,3 cc of warm ethyl alcohol and added 2,7 cc of physiological solution of sodium chloride. Injection of 0,1 cc of this solution into two female bitterlings gave lengthening of the ovipositors from 4 and 3 mm to 16 and 15 mm in 48 hours. 2 cc of the solution added to one liter of water caused the ovipositors of three bitterlings placed in the water to grow from 3,4 and 4 mm to 12,12 and 15 mm in 48 hours. These experiments were repeated with the same results. An active extract of the adrenal cortex (Cortin from the firm Organen), of which 2 cc were added to one liter of water, caused the ovipositors of bitterlings, placed in the water to react in the same way. By using the colchicine technique (Dustin,[14] Allen, Smith and Gardner[15]) we found that the application or corticosterone was followed by high mitogenetic activity in the ovipositor.

W. FLEISCHMANN
S. KANN

PHYSIOLOGICAL INSTITUTE,
UNIVERSITY OF VIENNA

SCIENTIFIC APPARATUS AND LABORATORY METHODS

MICRO-SCISSORS

ANY one who has made dissections of minute objects under the dissecting binocular microscope has felt the need of scissors more delicate and better adapted for such work than even the smallest scissors now available. The writer ordinarily grinds his dissecting needles so as to form knives with straight cutting edges. Some time ago it was realized that two such needle-knives mounted so as to oppose each other would serve as scissors (Fig. 1), and would, moreover, avoid certain disadvantages common to scissors of the conventional type, in which blades rotate on a pin thrust through the blades themselves. The mechanical difficulties inherent in a minute pin would be obviated and there would be the minimum area of overlapping of the blades in which bits of tissue could be lost. The chief problem was to mount the needles so that they could be readily and securely adjusted and be capable of easily controlled movement upon one another.

In early attempts to make such micro-scissors, the needles were mounted by a variety of methods so that, in effect, they replaced the tips of ordinary fine forceps. In one case the points of forceps were cut off and replaced by shafts of pure silver tipped with small chucks for holding the needles. The silver could be bent easily and would remain in adjustment reasonably well. Although somewhat awkward, such instruments made possible dissections such as slitting the body-wall of mosquito and sandfly larvae without much disturbance of the internal organs.

[2] W. Fleischmann and S. Kann, *Wiener klin. Wochenschr.*, 1574: 1932; *Pflügers Arch. f. d. ges. Physiol.*, 234: 130, 1934.
[3] H. Ehrhardt and A. Kühn, *Monatsschr. f. Gebhilfe*, 94: 1, 1933.
[4] Wunder, W., *Verhandl. Deutsch. Zoolog. Ges.*, 221, 1933.
[5] M. Matousek, *Biol. Listy*, 19: 89, 1934.
[6] D. J. Macht and H. F. Bryan, *Am. Jour. Physiol.*, 116: 103, 1936.
[7] A. E. Kanter, C. P. Bauer and A. H. Klawans, *Am. Jour. Obstet. and Gynec.*, 31: 764, 1936; *Jour. Am. Med. Asn.*, 103: 2026, 1934.
[8] H. Stiasny, *Zeitschr. f. Geburtsh.*, 116: 108, 1937.
[9] E. Marcus, *Zentralbl. f. Gynäköl.*, 61: 1943, 1937.
[10] J. S. Kleiner, A. J. Weisman and D. J. Mishkind, *Jour. Am. Med. Asn.*, 106: 1643, 1936.
[11] B. O. Barnes, A. E. Kanter, A. H. Klawans, SCIENCE, 84: 310, 1936.
[12] J. S. Kleiner, A. J. Weisman and D. J. Mishkind, SCIENCE, 86: 160, 1937.
[13] T. Reichstein, P. de Fremery, E. Laqueur, R. W. Spamhoff and J. E. Uyldert, *Nature* 26, 1937.
[14] A. P. Dustin, *Bull. Acad. Méd. Belg.*, 14: 487, 1934.
[15] E. Allen, G. M. Smith and W. U. Gardner, *Anat. Record*, 67 (Suppl. 1): 49, 1936.

The two models of micro-scissors here described represent more satisfactory solutions of some of the mechanical problems. The instrument in each case consists of a piece of metal shafting, about 7.5 mm in diameter by 10 to 12 cm in length, knurled, sawed down the middle for most of its length and provided at the open end with a pair of chucks or clamps for the needles. In the first model (Fig. 2) chucks cut from ordinary needle-holders are mounted on rods fastened to the shafting and bent so that the needles meet at an angle of about forty degrees, and move in a

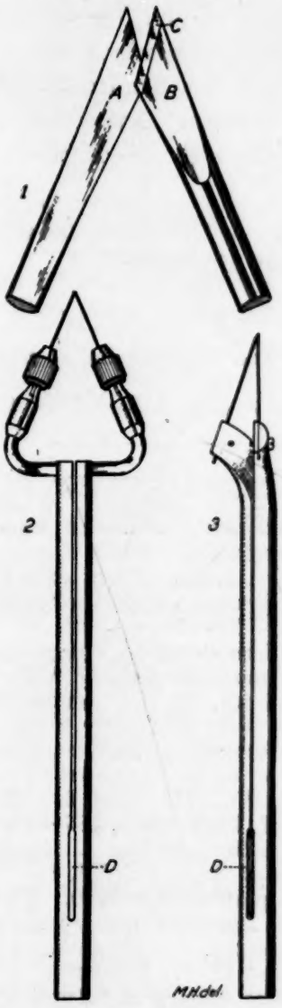

FIG. 1

plane at an angle of about fifteen degrees with the axis of the handle. The chucks have the disadvantage of rotating the needles slightly when being tightened, making difficult this delicate adjustment. In the second model (Fig. 3) the two halves of the split end of the handle are bent as shown in the figure and each end is in turn split, so that when provided with set-screws they form clamps for the needles. Grooves to fit the needles are drilled or filled on the inner surfaces of these clamps so that once the instrument is adjusted the axes of the needles are fixed. In each case the instrument may be regarded as an extreme modification of the well-known sheep-shears or grass-shears in which blades are caused to move on one another by squeezing the handle, wherein is embodied a spring. The instrument is held as one would hold an ordinary dissecting needle. Pressure upon the cylindrical handle in any position results in movement of the needle-blades. Set-screws to limit the motions of the two halves of the handle were found to be unnecessary. The proper tension is secured by widening the cut at the base of the handle as shown in the figures (*D*). The angle which the needles make with the axis of the handle affords the same advantage possessed by curved forceps over straight ones, namely, that the points may approach an object from various directions without changing the position of the hand.

The needle-blades are made of stainless steel surgical needles ("Anchor" brand, "straight intestinal," length about 63 mm, diameter about 0.7 mm). The slightly flattened and widened portion at the eye-end of the needle is ground to the shape illustrated in Fig. 1. Each blade has one perfectly plane surface (*A*), forming only a slight angle with the needle axis. A second surface (*B*) is ground so that its junction with the first (*A*) forms an angle of about thirty-five degrees with the needle axis. The edge thus formed is beveled slightly (*C*) to form the cutting edge. The two needle-blades are identical and interchangeable. When mounted in the instrument the two plane surfaces *A* face one another (Fig. 1). In adjusting the needles they are rotated on their axes until the cutting edges form a very small angle with one another as viewed along their plane of movement. Actual contact of the two blades in any position is thus limited to the single point where the cutting edges meet. As the needles move in cutting, the heel of the cutting edge of each needle rises slightly above the opposing surface *A*. The blades are under mutual pressure as they rest upon one another, which prevents them from separating while cutting. The correct pressure is secured by adjusting the instrument so that when the needles are separated and allowed to come to rest, their points exchange relative positions and are separated by about a needle's diameter. In use the blades may be separated for the purpose of inspection by spreading the two halves of the handle. After inspection the blades may be "lifted" back into cutting position with the fingers without affecting the adjustment.

The needle-blades should be ground on a fine oil-stone, such as Pike's "Hard Arkansas," which has been found quite satisfactory. The needles are held in a needle-holder or, better, in a machinist's pin-vise. With practice they may be ground under the binocular without any mechanical aid, but since successful operation of the scissors depends upon the ground surfaces, especially surface *A*, being perfectly plane, a mechani-

cal holder is desirable. All that is required is an adjustable clamp mounted on a base. Several such clamps have been improvised from apparatus found in the laboratory. A serviceable clamp was made from the small brass, standard-threaded parts purchasable at any electric-fixture counter. This assembly included a base, one or more ball-and-socket connections and a short piece of threaded tubing with a nut. A hole drilled through the tubing received the pin-vise, which was then clamped by screwing down the nut.

Adjustments for grinding are made under the binocular. The oilstone must rest on a firm base. The needle point is placed on the stone and, under the pressure necessary for proper grinding, is adjusted to the desired angle. Grinding is accomplished by moving either the stone or the whole needle-clamp assembly. The latter may be picked up and turned as a whole for inspection of the needle as often as desired without disturbing the grinding adjustment.

Needle-blades of any size, ground to a variety of shapes, may be fitted to the micro-scissors, enlarging their usefulness for many different types of work. The models described were made in the machine shop of the Harvard Medical School.

MARSHALL HERTIG

HARVARD MEDICAL SCHOOL
AND SCHOOL OF PUBLIC HEALTH
HARVARD UNIVERSITY

THE PREPARATION OF DOPA-MELANIN

THE work of Bloch,[1] Raper[2] and their co-workers has shown that natural melanin is most probably formed by the oxidation of tyrosine. The first oxidation product is dopa (l-3,-4-dihydroxyphenylalanine); dopa is oxidized to a red compound which, in the presence of oxygen, spontaneously changes to melanin (dopa-melanin).

Bloch and Schaaf[3] observed that dopa spontaneously oxidizes in alkaline solution to form dopa-melanin.

50 cc of a 0.01 *N* NaOH solution is saturated with dopa, and the resulting solution is placed in a 75 cc test tube. Air, saturated with water (to prevent excessive evaporation), is bubbled through this solution. The solution, which turns pink when the dopa and NaOH are mixed, quickly turns jet black. After 2 days, the melanin solution is made acid by the addition of 2 cc of 0.5 *N* HCl. The insoluble melanin is centrifuged down and the precipitate is washed 10 times with 10 cc portions of 0.005 *N* HCl. The melanin is now suspended in distilled water and transferred to an evaporating dish. The HCl is removed by evaporation to dryness on a water bath, after which the melanin is further dried over P_2O_5.

[1] Bloch, *Z. physiol. Chem.*, 98: 226, 1917.
[2] Raper, *Physiol. Rev.*, 8: 245, 1928.
[3] Bloch and Schaaf, *Biochem. Z.*, 162: 181, 1925.

Thirty-five to forty per cent. of the weight of the original dopa can be recovered as melanin by this method. Florence, Ensolme and Pozzi[4] have stated that the formation of melanin from tyrosine, using tyrosinase, is a limited reaction; the weight of melanin obtained in their experiments was about 40 per cent. of the initial weight of the tyrosine.

If stronger NaOH solution is used in making dopa-melanin, some of the pigment apparently is converted to a red-brown substance which is soluble in HCl.

It seems likely that natural melanin contains polypeptide side chains which are not present in synthetic melanin. Abderhalden and Guggenheim[5] have demonstrated that polypeptides which contain tyrosine will form melanin when they are oxidized in the presence of tyrosinase. Gortner[6] succeeded in isolating a melano-protein from the wool of black sheep.

L. EARLE ARNOW

THE LABORATORY OF PHYSIOLOGICAL CHEMISTRY,
UNIVERSITY OF MINNESOTA

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